Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Pd: \_\_\_\_\_\_

Chapter 18: Magnet Wars Lab

**Magnet Wars: What factors affect the strength of an electromagnetic?**

**Purpose:**  To observe the effects of the following on the strength of an electromagnet:

* My group will choose to change the \_\_\_\_\_\_\_# coils / core / wire\_\_\_\_\_ of the electromagnet.
* This is our \_\_\_\_independent / dependent \_\_\_\_\_\_\_\_ variable.

\***Note**\*: Strength will be indirectly measured by comparing the mass (number of) paperclips attracted

to the electromagnet.

**Hypothesis**: If \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**! Safety Disclaimer !** As electricity passes through a wire, some energy is lost as heat due to “internal

 friction” (also known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_). Things can quickly become too hot to

handle. Use caution! Connect and disconnect the circuit quickly.

* 6V lantern battery
* Digital scale
* Paper plate

**Materials (per group):**

* Ferromagnetic core (variety)
* Insulated wire (variety of insulators and sizes)
* Paperclips/staples in a cup

**Procedure:**

1. Using your wide array of electromagnet knowledge, choose a wire a ferromagnetic core sample. **Note**: the thicker the wire, the larger the core and the thinner the wire, the smaller the core.
2. Leaving some of the core exposed on both ends, wrap the wire around the core. Wrap neatly, evenly and be sure the coils are aligned. Your coils may also overlap one another. You will be allowed to design and test three versions of your electromagnet but only one will compete in the Magnet Wars competition.
3. Record the mass of each electromagnet in Data Table #1.
4. Test the electromagnet using the 6V battery and the alligator clip wires. Dip the electromagnet into the cup of paperclips/staples. Hold for **5 seconds** and then slowly withdraw the electromagnet from the cup.
5. Carefully move the electromagnet to the paper plate and disconnect the alligator clips from the battery.
6. Measure the mass of the paperclips you were able to pick up with the electromagnet. **ONLY THE PAPERCLIPS THAT STUCK TO YOUR ELECTROMAGNET WILL COUNT**. ANY PAPERCLIPS THAT FELL OFF ON THE WAY TO THE PAPER PLATE WILL NOT COUNT. Record the mass of the paperclips/staples from the electromagnet in Data Table #2. Complete 2 more trials with this electromagnet.
7. Repeat steps 3-5 with Electromagnet #2 and #3. Complete a total of 3 trials.
8. At this time, look at the data table and decide which electromagnet will be competing in the Magnet Wars competition (Remember: the magnet that will be crowned the winner will have the highest efficiency).
9. After the class Magnet Wars competition, record your 3 masses of paperclips and calculate the efficiency in Data Table #3.

**Results**:

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ were not changed in this experiment.

* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ was \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in every trial.
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ was \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in every trial.

**Data Table #1: Mass of Electromagnets & Independent Variable Variation**

|  |  |  |
| --- | --- | --- |
| **Electromagnet Name** | **IV Variation** | **Total Mass** |
| **EM #1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |  |  |
| **EM #2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |  |  |
| **EM #3\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |  |  |

**Data Table #2:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **DV: Mass of Paperclips (g)** | | | | **Circle the efficiency closest to 1 (may be over!)** |
| **IV: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Trial 1** | **Trial 2** | **Trial 3** | **Average Mass** | **Total Efficiency:**  **avg. mass of pc**  **mass of EM** |
| **(EM#1) IV#1: \_\_\_\_\_\_\_\_\_\_\_\_\_** |  |  |  |  |  |
| **(EM#2) IV#2: \_\_\_\_\_\_\_\_\_\_\_\_\_** |  |  |  |  |  |
| **(EM#3) IV#3: \_\_\_\_\_\_\_\_\_\_\_\_\_** |  |  |  |  |  |

**I will have Electromagnet # \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ competing in the Magnet Wars competition.**

**Data Table #3: Magnet Wars Finale**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IV: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Trial**  **1** | **Trial 2** | **Trial 3** | **Average Mass** | **Total Efficiency:**  **avg. mass of pc**  **mass of EM** |
| **(EM#\_\_) IV#\_\_\_\_: \_\_\_\_\_\_\_\_\_\_\_\_\_** |  |  |  |  |  |

**Analysis Questions:**

1. Using your data tables, which version of the independent variable had the greater efficiency? (include data!)
2. Why do you think this version of the independent variable had the greatest efficiency?
3. Look at the average mass of paperclips for each electromagnet. What can you conclude about the relationship between your independent variable and the strength of the electromagnet? (one statement)
4. Explain why another team (choose one) had a greater efficiency than you. (Discuss their IV and why that would create a stronger electromagnet).
5. Even if the results followed the predicted pattern, provide 2 sources of error that affected your results.

**Magnet Wars Grading**

**Group Rubric**

|  |  |
| --- | --- |
| **Category** | **Points Awarded/Points Possible** |
| Classwork and Participation | /20 |
| Efficiency of EM x 10 | /10 |
| Class Rank | /5 |
| Total Group Score | **/35** |

**Final Rubric**

|  |  |  |
| --- | --- | --- |
| **Points** | **Group Grade** | **Individual Grade** |
| **20** | * Classwork & Participation: group is prepared, able to collaborate, and stays on task throughout entire activity without teacher intervention. | Pre-Lab Questions, Data Tables, and Analysis Questions  (**20 points**) |
| **10** | * Efficiency of EM: efficiency x 10= total points earned \* see below\* |
| **5** | * Class Rank: \*see below\* | Total Individual  Score: \_\_\_\_\_\_\_\_\_\_\_\_\_/20 |
| Total Group Score: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ / 35 | |
| **Group + Individual Points = \_\_\_\_\_\_\_\_\_\_ / 55** | | |

**How will efficiency be scored?**

10 points will be determined by efficiency (without being compared to other groups). Your objective is to get the highest efficiency (1!).

Example: 40g PC = .57g x 10 = 5.7 points earned

70g EM

* A magnet that supports its own mass will score a perfect 10 points.
* Otherwise: Mass of PC = \_\_efficiency\_\_ x 10 = points earned

Mass of EM

* For every 0.25 above an efficiency of 1, 0.5 points will be awarded. No more than 3 total extra credit points can be earned.

**How does class ranking play a role?**

* 1st place= 5 points, 2nd place= 4.5 points, 3rd place= 4 points, etc.